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An analysis on health care costs due to accidents involving powered two wheelers to increase road safety

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Abstract

Powered Two Wheelers (PTWs) provide a convenient mode for a large portion of population in many cities. At the same time PTWs present serious system problems, the most important being poorer safety if compared to other motorized modes. But even when lower safety levels are acknowledged, problems behind are far from being solved. Rome is an example: although PTWs accidents rates are not negligible, the need for a specific safety policy is still unmet. Therefore the local Mobility Agency appointed the authors of this paper for a study of PTWs accidents occurring in the urban area. An assessment of the associated health care costs was also required. The objective of the paper is to report the main outcomes of this study highlighting recurring features of PTWs accidents, the high health care costs and how to quantify the economic resources to improve safety. The methodology was based on three steps: i) an analysis of the causes of PTWs accidents, which resulted into the location of black spots and assessment of the severity of the events; ii) the estimation of health care costs after a scientific literature review; iii) the association of health care costs to black spots and accidents severity to rank interventions to improve PTWs safety. This led to a final list of roads where PTWs accidents of the highest severity occurred and the required economic resources to improve their safety level. This stressed, for the first time, the unaffordable expenditures due to PTWs accidents. In conclusion, the issue whether the awareness of such costs can be used as leverage for more mindful behaviors among the riders is addressed.

Peer-review under responsibility of Road and Bridge Research Institute (IBDiM)

Keywords: road safety; Powered Two Wheelers; health care costs; safety potential index

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1. Introduction

The magnitude of the overall road safety crisis is largely acknowledged worldwide: according to the World Health Organization (WHO) “the economic consequences of motor vehicle crashes have been estimated between 1% and 3% of the respective GNP of the world countries, reaching a total over $500 billion” (WHO 2010).

Still, decision-makers seem to underestimate the relevance of public health care costs to recover and rehabilitate those involved in road accidents. For what strictly concerns PTWs, there are many contributing factors. At national level, emphasis is obviously placed on prevention, thus enforcing stricter and stricter regulations to mandate comprehensive sets of safety measures (for example compulsory helmets; restrictions for novices; vehicle improvements such as enhanced brake systems or anti-tampering measures, etc.). Not the same can be said in terms of efforts to promote and enforce effective and consolidated post-crashes response procedures. According to the WHO (2013), if considering the Countries with >1,000,000 inhabitants and with riders accounting for about ≥ 1/3 the deceased (table 1), it is clear that the quality of post-crashes care response procedures is far from being adequate (also in some high income countries).

At local level, reasons of underestimation rely on the general approach to mobility problems, as policies with respect to the use of two-wheelers and whether special facilities should be provided are typically non-existent. The involvement of Powered Two-Wheelers (PTWs) in mobility plans is quite rare, being this mode considered by decision-makers as either not a priority (when PTWs are not among the dominant modes) or too sensitive to reach consensus (in areas where they are dominant, as observed in Musso et al. 2010).

Table 1. Countries with PTWs highest fatality rates.

Country	PTWs as dominant mode (Yes/No)	Helmet wearing rate (%)		Deceased drivers/ passengers of PTWs (% of all reported road traffic deceased)	Post-crashes care response procedures		
					Seriously injured transported by ambulance (%)	Emergency medicine training (Yes/No)	
		Driv.	Pass.			doctors	nurses
Laos**	Yes	75	n.a	74.5	≤10	Yes	No
Thailand**	Yes	53	19	73.5	50–74	Yes	No
Cambodia*	Yes	65	9	66.6	11–49	Yes	Yes
Malaysia**	Yes	76 (all riders)		58.7	≥75	Yes	Yes
Dominican Republic**	Yes	n.a	n.a	57.8	n.a	Yes	No
Benin***	No	n.a	n.a	50.2	-	Yes	Yes
Singapore*	No	n.a	n.a	46.1	≥75	Yes	Yes
Paraguay**	No	45	20	41.4	50–74	Yes	No
Colombia**	Yes	99	40	39.1	11–49	Yes	Yes
Pakistan**	Yes	10 (all riders)		38.6	11–49	Yes	No
Indonesia**	Yes	80	52	35.7	≤10	Yes	Yes
Cyprus*	No	75	68	35.0	≥75	No	No
China**	n.a.	n.a	n.a	34.5	≥75	Yes	Yes
India**	Yes	50	≤10	32.4	11–49	Yes	Yes
Greece*	No	74	34	30.6	n.a	No	No
Italy*	No	92 (all riders)		30.3		Yes	Yes
Guatemala**	No	40 (all riders)		30.0	≥75	Yes	No

Income: *high, **middle, ***low

2. PTWs in Rome, main facts and figures

Although road safety has become a central issue in the Italian political agenda and the consequent awareness of the higher vulnerability of PTWs increased, Rome is no exception in the lack of a proper approach to PTWs safety problems and the local situation reflects contradictions and efforts to manage a locally very popular mode of transportation in an urban context where policies to achieve more sustainable mobility patterns still do not fully succeed.

The city's vehicle ownership rate, as recorded in 2013, is one of the highest in Europe: 917.6 vehicles (two--wheelers included) per 1000 inhabitants (including the infant and senior populations). The estimated number of two-wheelers is about one for every five inhabitants (Rome Municipality 2009). PTWs are part of the mobility of everyday life: more than half of the overall number of trips by two-wheelers occurs in a distance range between 2 and 11 km (just as for cars), and even for walking distances (0 to 1 km), the use of mopeds and motorcycles is still an option (ATAC 2005). This and the high local PTWs fatality rates, i.e. 31.26 fatalities per million inhabitants (Surace et al. 2010), among the highest in Italy (average rate in Italy 19.0 and in the EU-24 12.9, according to ERSO 2012), makes an example of the importance of this issue. According to the Rome Municipality database, a focus on accidents occurred between 2010 and 2012 highlights that: the amount of injured and deceased riders (on both mopeds and motorcycles) is virtually equal to that of drivers, respectively 42.2% and 43.8%; during nighttimes about 1/4 of road users involved in accidents are riders; according to table 2, in general mopeds seem to be quantitatively less affected than motorcycles, but during nighttimes the ratio between event and involvement (both as deceased and injured) is virtually equal to 1 and the vehicle is always damaged.

Table 2. PTWs accidents in Rome, 2010–2012.

Mode	Period	6h31–22h29			22h30–6h30		
	Year	Deceased (unit)	Injured (unit)	Events (unit)	Deceased (unit)	Injured (unit)	Events (unit)
private cars	2010	18	7,420	27,816	20	2,290	5,065
	2011	19	7,496	27,744	22	2,213	4,936
	2012	21	6,348	24,625	15	1,989	4,267
mopeds	2010	6	979	1,487	2	133	157
	2011	1	969	1,414	3	129	172
	2012	3	748	1,099	1	93	136
motorcycles	2010	47	7488	9,605	13	685	774
	2011	45	7906	9,991	16	715	815
	2012	25	6382	8,260	12	560	627
bicycles	2010	2	175	214	1	6	9
	2011	1	205	263	0	10	16
	2012	5	207	283	0	17	20
pedestrians	2010	38	2,070	2,102	11	172	169
	2011	45	2,040	2,100	11	167	163
	2012	39	1,952	2,005	17	159	169

Strictly focusing on nighttimes occurrences, the majority of injured riders involved in an accident is aged between 18 and 29, but those under 18 (mostly minors, as pillion riders) are not a negligible group, especially for mopeds (51% of accidents with injured victims are riders younger than 18 years old). Novices and young riders (< 39 years old) record lower helmet wearing rate than their senior peers, but the overall community is in line with the national rate reported in table 1.

The driving environment (weather conditions, maintenance and quality of the infrastructures, availability and appropriateness of signs and street lighting, level of traffic, etc.) cannot be considered a contributing factor in the occurrence of accidents, as in the overwhelming majority of cases all these aspects were of no relevance; in fact, circumstances could be defined as “ideal” for safe ridership (good weather conditions, roads with good maintenance level, appropriate provision of traffic signs and street lighting, poor occurrence of congestion phenomena). On the contrary, behaviors resulted far from optimal: exceeding speed limits (15% for both mopeds and motorcycles); inattentive driving (respectively 24% for mopeds and 17% for motorcycles); inappropriate behaviors (29% for mopeds and 13% for motorcycles) and sudden braking (13% for mopeds and 21% for motorcycles) are among the most recurring causes of accidents (among which neither DUI nor drink driving are recorded). All of the above stresses how riding during nighttimes is not just a downscaled version of daytime problems, but is an unsafer activity also in light of the reduced amount of circulating vehicles; this prompted the Mobility Agency of Rome Municipality to include this specific safety issue within a more general study to reduce speed in night hours.

Including PTWs in such study meant also the opportunity to in-depth study the specific health care costs related to accidents involving riders for the first time, and address this issue to the road safety inspection processes, so to have a final classification of road sections which result to be unsafe for PTWs and the improvements that can be planned to increase their safety levels.

3. Assessing the health care costs

Scientific literature on social costs of road accidents abounds and so the general estimation procedures for health care costs as part of the calculation of the overall road safety social costs (Hakkert and Wesemann 2005, Elvik 1995). The specific “items” which constitute the list of costs differ among the Countries: from first aid to recovery, up to funeral expenses in some cases. But, even when focusing on the four main basic expenditures (First aid and emergency room, Ambulance, Recovery and Rehabilitation) scientific and grey literature show differences in the units of measurements or assessment criteria (table 3).

Table 3. Average health care costs in selected countries.

Country	Type of cost and units of measurement				Source
	First aid and emergency room	Ambulance	Recovery	Rehabilitation	
Austria	54.3 Euro/p	n.a.	273 Euro/p per day	207 Euro/p	Meerding and Toet 2002
Greece	51.36 Euro/p	n.a.	142 Euro/p per day	n.a.	Meerding and Toet 2002
The Netherlands	99 Euro/p	143 Euro/trip	356 Euro/p per day	257 Euro/p	Meerding and Toet 2002
Spain	74.99 Euro/p*	20.61 Euro/trip	15,832 Euro/p per stay	n.a	Bastida et al. 2004
	From 722.51 to 265.95 Euro/p per severity level	n.a.	240.09 Euro/p per day	From 18,655.26 to 10,660.15 Euro/p per year per severity level	Soriano Somovilla 2010
	82.99 Euro/p*	24.61 Euro/trip	18,832 Euro/p per stay	n.a.	Garcìa Altés and Pérez 2007
Italy	From 10,760 to 69.2 Euro/p per severity level at triage	n.a.	From 2,227 to 8,213.8 Euro/p according to duration	From 19,812 to 10,775 Euro/p according to Barthel scale	Chini and Farchi 2011
	142 Euro/p	26 Euro/p	3988 Euro/p	From 222 to 74 Euro/p per severity level	Lattarulo 2012
United Kingdom	From 1,067 to 1,298 GBP/p per severity level	n.a.	From 17,421 to 6,413 GBP/p*	n.a.	Jeffrey, 2010
	From 1,006 to 13,671 GBP/p per severity level	n.a.	n.a.	n.a.	DfT 2013

USA	From 54 to 38 USD/p according to gender	n.a.	From 54 to 314 USD/p per day, per severity level, according to gender	n.a.	Naumann et al. 2010
	From 47.895 to 8.779 USD/p per severity level			From 67.565 to 26.871 USD/p per severity level	Malchose, and Vac hal 2010.
Australia	From 8.246 to 40 AUSD/p per severity level	From 462 to 336 AUSD/p per severity level	From 5,493 to 28 AUSD/p per severity level	90,476 AUSD/per year	Baldock and McLean 2005
	7,114 AUSD/p	2,372 AUSD/event	From 1,008 to 959 AUSD/p per day according to facility (public/private)	n.a	Risbey et al. 2010.
New Zealand	From 600 to 2,009 NZD/p per severity level	n.a.	From 100 to 8,008 NZD/p per severity level	From 100 to 4,300 NZD/p per severity level	MTNZ 2013

In Italy recent guidelines, issued by the Ministry of Transport, for the estimation of social costs due to road accidents (MIT 2012a) provide a reference value for the calculation of health care costs which is 1,965 Euro per person.

Such reference value appears clearly underestimated if compared with those reported in table 3 (one reason for all: it does not include costs for rehabilitation) and local experiences demonstrate that actual costs are far beyond the provided reference (Chini and Farchi 2011, Lattarulo 2012). For the case of Rome, however, it was decided to assume the reference value as a minimum in the calculation of the health care costs (table 4).

The estimated average expenditure per year due to health care for motorcycles adds up to 15,650,570 Euros whereas that of mopeds to 2,008,552 Euros, which translated into a yearly theoretical cost per inhabitant of about 7 Euros (still including those who has no or poor access to this mode as the infant and the senior populations). If referred to the registered local PTWs fleet, the yearly theoretical cost per vehicle is around 35 Euros. Needless to say, such values could reasonably increase if expenditures due to rehabilitation and home recovery would have been included in the reference value. Had such costs been calculated according to the method applied in the neighbouring region of Tuscany (Lattarulo 2012) thus including also costs for rehabilitation and more comprehensive standards, the average yearly expenditure of 41,679,615 Euros (that covers all fatalities and injured individuals, by all modes), would have virtually doubled, up to 91,292,144 Euros.

Table 4. Estimated health care costs of accidents involving PTWs in Rome.

Year	2010		2011		2012	
Period	6h31–22h29	22h30–6h30	6h31–22h29	22h30–6h30	6h31–22h29	22h30–6h30
Mode	health care costs (Euro)					
pass. cars	14,615,670	4,539,150	14,766,975	4,391,775	12,515,085	3,937,860
mopeds	1,935,525	265,275	1,906,050	259,380	1,474,715	184,710
motorcycles	14,806,275	1,371,570	15,623,715	1,436,415	12,589,755	1,123,980
pedestrians	4,242,435	259,380	4,161,870	284,925	3,983,055	275,100
bicycles	347,805	13,755	406,755	17,685	424,440	25,545

4. A method to improve PTWs safety conditions

Within the study to reduce speed in night hours, the acknowledgement of the entity of such expenditure was associated to the location of the accidents involving PTWs across the whole urban area, which was done utilizing a full featured Geographic Information System (GIS) model. This was not aimed at just creating a map of black spots, but at identifying links (or part of them, as “sub-links”) with the same accidents density. Additional information on PTWs associated to each link or sub-link included indicators as: a) Frequency of accidents with fatalities (events according to fatalities/km); b) Frequency of accidents with injured individuals (events according to injured riders/km); c) Frequency of accidents (events/km); d) Frequency of fatalities (fatalities/km) and d) Frequency of injured riders (injured riders/km); along with data such as the street name, traffic flows, length of the link, etc.

This allowed to assess whether these links (Figure 1), and the information associated to them, can become elements of priority when planning road safety interventions (which, on the contrary, are usually planned assuming the safety of private cars as major elements of decision). An opportunity to assess the possibility to revise such usual course of safety interventions is given by the recent national decree on road safety inspections (MIT 2012b) which enforces the possibility to calculate a specific indicator, i.e. the Safety Potential (σ). This indicator allows to draw a priority list of road links for which is of the utmost importance to intervene to improve safety, by assessing the consequent expected reduction of accidents and costs to these associated.

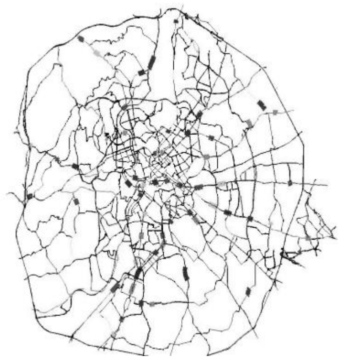

Fig. 1. Road links according to PTWs accidents density.

4.1. The calculation of the Safety Potential σ

The Safety Potential σ (kEuro/km*year) can be calculated as the difference between ADAC as $\delta_{C_a}^{m}$ (the Average Density of Accident Costs) and BRADAC as $D_{C_a}^{m}$ (the Basis Rate of the Average Density of Accident Costs), i.e. as:

$$\sigma = \delta_{C_a}^{m} - D_{C_a}^{m} = \\ = \frac{C_a^A}{L} - \frac{C_a}{L \cdot t} \cdot 10^{-3} \tag{1}$$

$\delta_{C_a}^{m}$ is calculated as the ratio between the average yearly cost of accidents C_a^A (kEuro/year) and the length of the considered road section L (km), as:

$$\delta_{C_a}^{m} = \frac{C_a^A}{L} \tag{2}$$

where C_a^A is the sum of fatalities and injured and the associated costs.

More specifically:

$$C_a^A = \sum_k (\mathrm{N}_k \cdot \mathrm{C}_k) = \\ = \mathrm{N}_F * \mathrm{C}_F + \mathrm{N}_S * \mathrm{C}_S + \mathrm{N}_M * \mathrm{C}_M \tag{3}$$

with N_F, N_S and N_M, respectively the yearly amount of fatalities, severely injured and lightly injured, and C_F, C_S and C_M (k€) respectively the corresponding average costs for fatalities, severely injured and lightly injured.

$D_{C_a}^m$ is calculated as:

$$D_{C_a}^m = \frac{(R_{C_a} \cdot 365 \cdot \Phi_d)}{10^6} \tag{4}$$

where:
ACR as R_{C_a} (€/1000*veh*km) is the Accident Cost Rate and ADT as Φ_d (veh/day) is the Average Daily Traffic (BAST-SÉTRA 2005). More specifically, R_{C_a} is calculated as:

$$R_{C_a} = \frac{1000 \cdot C_a}{365 \cdot \Phi_d \cdot \mathrm{L} \cdot \mathrm{t}} \tag{5}$$

where C_a is calculated as:

$$\begin{aligned} C_a &= \sum_J \left(\mathrm{A}_j \cdot \mathrm{C}_j^m \right) = \\ &= \mathrm{A}_{FS} \cdot \mathrm{C}_{FS}^m + \mathrm{A}_M \cdot \mathrm{C}_M^m + \mathrm{A}_D \cdot \mathrm{C}_D^m \end{aligned} \tag{6}$$

with A_{FS} as the sum of the number of fatal accidents and that of accidents with severe injuries, A_M as the amount of accidents with minor injuries, A_D as the amount of accidents with no fatalities/injuries and C_J^m as the average cost per accident category *J*; t is the number of years of the analysis period. Reference values of such parameters are provided by the aforementioned decree.

In the nighttime assessment, Φ_d in eqn (4) and eqn (5) was substituted by the Average Nighttime Traffic (ANT-Φ_n), in veh/day, which includes the estimation of nighttime flows on the network from 22h30 to 6h30.

4.2. The Safety Potential for PTWs

A previous study successfully tested the possibility to apply σ for a very small fleet of PTWs (Sgarra et al. 2014), and paved the way for the estimation of σ for the first time at city scale. The most interesting results concern the nighttime situation, due to the criticalities observed in the analysis previously reported in section 2, which allowed to draw a priority list including 150 roads across the whole urban area.

From the first 30 ranked links (table 5) some considerations on the entity of improvements to increase safety for PTWs, especially during nighttimes, arise. The majority of links from which it is possible to save more in term of social costs, on a yearly basis, and thus calls for more urgent road safety interventions for PTWs, are main collector roads and provide connections between collector and arterial roads; therefore interventions aimed at reducing speed may be beneficial to the other motorized modes, as well, given the high traffic flows occurring on such links.

Land use seems to affect the ranked links too: a number of links is located in historic central (Figure 2) and semi--central areas, some of which with premium value built environment, not planned to meet requirements typical of motorized modes.

PTWs high traffic volumes in such areas are due to the local nightlife attractiveness (it is worth reminding that two-wheelers and especially mopeds are the most popular mode for hanging around); on the other, many links are located at mono-functional areas, mostly residential, where especially in nighttimes their function turns into the provision of faster connections, similarly to arterial roads. The link ranked first serves as a case in point: a road connecting two city landmarks (the Coliseum and the Roman Forum) to one of the most important square, Via dei Fori Imperiali is no longer accessible for private cars and PTWs; in 2013 the Municipality acknowledged its role of pedestrian realm (also after some fatal accidents involving cyclists) and turned it into a semi-pedestrianized area accessible by buses, only. Its highest σ value was just one more evidence of its unsuitability as collector road and of its poor safety level for all the modes.

As expected, the calculation of daytime σ highlights higher values than the nighttime ones, due to the higher traffic flows; however, it is not infrequent that for some of the links with a higher amount of daytime accidents (and among these some of those reported in table 5), σ nighttime values are nonetheless higher due to the higher accidents severity in this period.

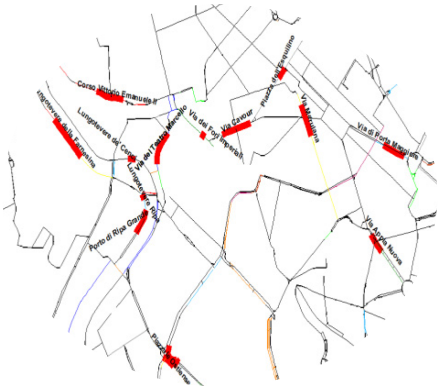

Fig. 2. Ranked links in the city center.

Table 5. Estimated σ for PTWs in Rome, first 30 ranked links.

Year	Link (streetname)	σ [KEuro/(Km year)]	Street function	injured/deceased (unit)	
2010	Fori Imperiali*	25,037.9	Collector	1	σ > 25,000
2010	Lungotevere dei Cenci*	23,127.4	Main Collector	10	24,999 > σ >10,000
2010	Tor Tre Teste A	20,130	Collector	10	
2011	Prenestina C	15,718.6	Collector	19	
2010	Ettore Rolli	11,051.8	Collector	3	
2010	Cristoforo Colombo F	10,275.6	Main Collector	6	
2010	Foro Italico**	10,128.2	Arterial	2	
2010	Lungotevere Maresciallo Diaz**	9,620.6	Main Collector	4	9,999 > σ > 5,000
2011	Sorbona	9,310.3	Main Collector	3	
2010	Cilicia**	8,705.6	Main Collector	12	
2010	Cristoforo Colombo A	7,774.7	Main Collector	5	
2010	Marconi A	7,271.4	Collector	7	
2010	Porta Maggiore*	6,724.5	Collector	3	
2010	Corso d'Italia A*	6,548.4	Collector	2	
2012	Porto di Ripa Grande*	5,973.6	Main Collector	4	
2011	Flaminia Nuova A	5,725.8	Main Collector	11	
2010	Tiburtina B	5,647.7	Collector	3	
2010	Lungotevere della Vittoria**	5,523	Main Collector	1	
2012	Cristoforo Colombo C	5,387.3	Main Collector	2	
2010	Cristoforo Colombo C	5,327.2	Main Collector	1	
2012	L. in Augusta*	5,263	Main Collector	8	
2012	Teatro di Marcello*	5,132.5	Collector	2	
2011	Cavour*	5,045.5	Main Collector	10	
2012	Cassia B	4,883.2	Main Local	9	4,999 > σ > 4,000
2011	Lungotevere. Farnesina*	4,754	Main Collector	1	
2010	Bravetta	4,672.3	Collector	3	
2011	Casilina D	4,655.1	Collector	4	
2012	Monti Tiburtini	4,418.4	Main Collector	1	
2012	Marconi B	4,340.7	Collector	2	
2011	Laurentina	4,316	Collector	2	

*central **semicentral

4.3. *The estimation of the Safety Potential for events involving other modes*

Table 5 reports the top priority links to consider to improve safety, but the list of 150 roads above-mentioned also includes multimodal events. The estimation of σ, *per se*, is as a matter of fact easily adaptable to events involving other modes (both non-motorized and motorized ones), provided to have the data and the information needed for its calculation available. Therefore, the possibility to extend the Safety Potential calculation for passenger cars, heavy vehicles or pedestrians has to address the issue of the likely unavailability of such knowledge base of consolidated data to calculate ADAC and BRADAC for the other modes. The lack of such resources can be, then, the actual barrier for the calculation of the Safety Potential. On the contrary, the possibility to calculate σ including all the modes and multimodal events might result into a more detailed estimation of the Safety Potential, since it might be based on the total amount of occurring accidents and thus enable to estimate probably higher, but even more realistic σ values. As a consequence, the calculation of multimodal Safety Potential could help increase the accuracy of priorities, as it might identify links to intervene to improve safety, resulting from the assessment of the expected reduction of all the accidents (not only those involving just PTWs) and their associated costs.

5. Conclusions

Health care costs due to road accidents are difficult to assess, and in the Italian case regulations can lead to underestimate them. But even so, the awareness of their volume, especially if related to modes not central in the mobility policies, as PTWs, stresses the need to increase even more safety levels and improve the quality of post-crashes responses. The knowledge of the entity of such expenditures could also largely improve accuracy in the analysis of black spots in general and, more specifically, help detect critical road sections and determine, by the calculation of σ, how much could be saved thanks to appropriate interventions.

The case study of Rome is an evidence of how a regular assessment of σ could pave the way for major improvements in the field of safety; prospective applications might involve the possibility to draw up maps of roads classified according to risk levels, useful to monitor PTWs accidents and prevent further occurrences. Such maps, updated in real-time and also available on navigation systems and web portals, can be used to manage infrastructures through a plan of priority interventions to continuously improve current safety levels. The method for calculating σ is not only adaptable to events involving other modes, but also easily transferable to other cities. However, the Safety Potential, as based on accident data regularly collected by the municipalities, stresses the need to have homogeneous parameters to assess the costs for road accidents and especially the health care costs, at least at European level. The analysis of scientific literature highlighted very different approaches in considering which “items” have to be considered in the list of health care costs, and the poor accuracy of those too general, which leads to a general underestimation of the expenditure. The next research question open to decision-makers and scientists, for a shared procedure for calculating these costs, is then two-pronged: on the one hand, it is necessary to determine, under the medical point of view, the appropriate care treatments and the corresponding costs on national basis. This is not an easy task as injuries and post-crashes responses to medical treatment and rehabilitation vary (per severity of injuries, mode involved, age and vulnerability of victims, etc.), but the huge practice in this field could provide a sound basis for a health care costs registry at European level. On the other hand, nothing of the above can be enforced without a strong political willingness to promote common, equal opportunities to provide appropriate rehabilitation procedures for all the road safety victims across Europe. This requires supranational regulatory tools, specific funding and a stronger awareness of the entity of these costs. The calculation of σ, by assessing the consequent expected reduction of accidents and costs to these associated, stresses how such costs are per se not affordable for a community. It is not surprising, then, that thus far the underestimation of such costs is the only way to cope with their unaffordability. To conclude, the issue whether the awareness of such costs can be used as leverage for more mindful behaviors among the riders is one more open research question. It is difficult to assess whether the health care yearly theoretical cost per inhabitant of about 7 Euros calculated for the Roman riders can be a convincing argument. A survey run in Rome in 2007 aimed at profiling typical local two-wheeler users was decisive to determine that costs in general were not so relevant: according to drivers and riders responses, the annual maintenance costs for two-wheelers were higher than those for cars (respectively about 0.31 and 0.22 €*km) (IAC, 2008), but worth to be “paid” thanks to the higher personal convenience and freedom provided by this mode. In light of these responses, probably 7 Euros can be considered a minor cost to access privilege and independence, but this is one more evidence that more in the field of safety awareness among the riders community can be done.

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